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LESSON 234-308-6.5

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STUDENT GUIDE

52D10
POWER GENERATION EQUIPMENT REPAIRER
SKILL LEVEL I

TROUBLESHOOT THE CONTROL PANEL (ORGANIZATIONAL)

FOR U.S. ARMY RESERVE SCHOOLS

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D 103.6/5:

READ

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STUDENT DIRECTIONS

R E A D

This Student Guide will lead you through the "Troubleshoot the Control Panel (Organizational)" Lesson step-by-step. You will start with the directions below. Additional directions will be given to you during the presentation at the top and bottom of the pages in this Student Guide. It is important that you follow the directions exactly and complete each step before going on with the next step. If at any time the directions are not clear or you get lost, ask your instructor for help.

1. Read the Lesson Objective to find out what you are expected to learn. Do this now.

2. Read the Performance Test Directions and study the Performance Checklist. If you think you can pass this test, ask the instructor to give you the test now.

LESSON OBJECTIVE

LESSON: Troubleshoot the Control Panel (Organizational)

CONDITIONS: Given a 30 kw generator set, diesel engine driven, general mechanic's tool kit, ohmmeter and TM 5-6115-465-12.

STANDARDS: The student will be able to trouble shoot the 30 kw generator control panel in accordance with TM 5-6115-465-12 and the lesson.

ENABLING OBJECTIVES

The student will be able to:

1. **Troubleshoot control box assembly components.**
   - **(a) Inspect wiring harness for defects.**
   - **(b) Test AC voltmeter for operation.**
   - **(c) Inspect thermal watt converter for external damage.**
   - **(d) Test rheostats for resistance.**
   - **(e) Inspect frequency transducer for defects.**
   - **(f) Test operations switch.**
   - **(g) Inspect gages for external damage.**
2. **Troubleshoot the generator set controls.**
   - **(a) Test DC circuit breaker terminal for operation.**
   - **(b) Test manual speed control for operation.**
   - **(c) Test fault indicator for defects.**

NOTE: You are ready to read the lesson presentation. The lesson will tell you when to answer the Self-Check Questions. Don't forget to follow the directions at the top and bottom of each page in the Student Guide. Start reading now.

INTRODUCTION

This lesson contains organizational Maintenance of the generator set controls, the control box assembly and the fault locators for controlling and monitoring the operation of the generator set. The 50/60 Hz and 50/60 Hz tactical precise model incorporate a governor control unit which operate the hydraulic actuator to change the governor setting. This function is fulfilled by the manual speed control on the tactical utility model. The interconnecting wiring harness provides electrical connection between the major assemblies and the control box and fault indicator panel.

1. Troubleshoot the Control Box Assembly Components

WARNING

THE GENERATOR SHALL BE SHUT OFF AND THE BATTERY DISCONNECTED PRIOR TO PERFORMING MAINTENANCE ON THE CONTROL BOX ASSEMBLY. FAILURE TO OBSERVE THE WARNING MAY RESULT IN ELECTRICAL SHOCK OR DEATH BY ELECTROCUTION.

A. Inspect the Control Box Wiring Harness.

NOTE

In order to conduct a thorough examination of the wiring harness it will be necessary to remove it. When removing it, use care to tag all leads securely to aid in their proper connection.

1. Tag all electrical leads to control panel assembly.

2. Disconnect all electrical leads.

3. Using figure 1, sheet 1, as a guide disconnect the following harness mounting hardware and remove the wiring harness. Disconnect and remove the wiring harness. Disconnect and remove items 46 through 60 with the exception of item 51. This self-locking nut should not be removed unless its replacement is necessary due to damage.

4. Cleaning and inspection.

   (a) Clean wiring harness assembly with filtered compressed air and a soft bristle brush or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

   (b) Visually inspect wiring harness connector for cracks, corrosion, bent or broken pins, and stripped or damaged threads.

   (c) Inspect insulation for burns, chafing, and deterioration.

   (d) Check electrical leads for burned, bent, corroded, damaged or missing terminals.

5. Testing. Check continuity of individual wires with a multimeter or continuity light using figures FO-1 and FO-2 as a guide.

NOTE

If more than 30 percent of the wires are damaged or have been repaired, replace the wiring harness and forward it to high level maintenance for rebuilding.

6. Installaltion: After the harness has been repaired or a replacement obtained reinstall the harness in the reverse order of removal procedures.

B. Test AC Voltmeter for Operation.

1. Disconnect and tag the meter electrical leads and remove the voltmeter (item 37, figure 1-a).

2. Testing:

If the AC voltmeter is suspected of being faulty, test by temporarily replacing with another known serviceable AC voltmeter. If the incorrect reading persists original meter is serviceable and should be reinstalled.

C. Inspects the Thermal Watt Converter for External Damage.

1. Tag and disconnect electrical leads to the thermal watt converter and removes the assembly (item 31, figure 1).

2. Clean the unit with compressed air and visually inspect it for dents, cracks, corrosion, damaged threads and evidence of shoring. Replace the unit if damage is found.

3. Install in the reverse order of removal.

D. Test Rheostats for Resistance.

1. Frequency adjust rheostat (precise sets only). (Figure 1, Sheet 2.)

a. Tag and disconnect electrical lead to frequency adjust rheostat. Remove the frequency rheostat. (65)

b. Test the rheostat by connecting an ohmmeter across outer terminal; of rheostat. Ohmmeter should indicate 500 ohms resistance. Rotate rheostat at shaft to the left as far as it will go. Connect ohmmeter between the center terminal and either outer terminal, the ohmmeter should indicate 0 ohms resistance. Now slowly, at an even rate, rotate the rheostat shaft to the right as far as it will go. The ohmmeter should increase at an even rate from 0 to 500 ohms. If the ohmmeter changes erratically or is not 500 ohms when the rotation is completed. The rheostat is defective and should be replaced.

READEX FICHE best copy available

2. Voltage Adjust Rheostat. (Figure 1, Sheet 2)

Tag and disconnect electrical lead to voltage, adjust rheostat (item 69). Remove and test the rheostat as follows:

a. Connect an ohmmeter. Cross two outer terminals of rheostat. Indication should be 250 ohms resistance.

b. Rotate rheostat shaft counterclockwise as far as it will go.

c. Connect ohmmeter between center terminal and either outer terminal.

d. Slowly, at an even rate, rotate rheostat shaft clockwise as far as it will go while observing the ohmmeter.

e. Ohmmeter indication should increase, at an even rate, from 0 to 250 ohms resistance.

f. If ohmmeter indication changes erratically or is not 250 ohms when rotation is complete, the rheostat is defective and shall be replaced.

E. Inspect Frequency Transducer for Defects. (Figure 1, Sheet 1)

1. Disconnect and tag the electrical lead to the frequency transducer (item 24). Remove the frequency transducer from the control box.

2. Clean the frequency transducer with filtered compressed air or wipe with a clean, lint-free cloth. Inspect the frequency transducer for dents, cracks, corrosion, and other damage. Replace unit if damage is found.

F. Test the Operations Switch.

1. Disconnect and tag the electrical lead to the operations switch (78) and remove the operation switch from the control box.

2. Testing of the operations switch will be done as follows:

a. Place switch in the "PARALLEL OPERATION" position (lever away from mounting post key way).

b. Using an ohmmeter, check for continuity between each center terminal and corresponding upper terminal.

c. Place the switch in the "SINGLE UNIT OPERATION" position (lever toward mounting post key way).

d. Check for continuity between each center terminal and corresponding lower terminal.

e. Replace the switch if any discontinuity is noted.

G. Inspect the Gages for External Damage. (Figure 1, Sheet 1.)

Disconnect and tag all electrical leads to the gages (items 4, 8, 12). Remove the gages and inspect them for corrosion, cracked casings, cracked or broken glasses, stripped or otherwise damaged threads, and evidence of other damage. Replace damaged gages.

II. Troubleshoot Generator Set Controls

A. Test DC circuit breaker terminals for operation (figure 2).

1. Tag and disconnect the electrical leads to DC circuit breaker.

2. Testing of the DC circuit breaker will be conducted as follows:

a. Using a ohmmeter, check for open circuit across the circuit breaker terminals.

b. Depress the circuit breaker button and check ohmmeter indication. Ohmmeter should indicate continuity.

c. Replace the circuit if any of the requirements of the above list are not met.

B. Test the Manual Speed Control for Operation.

Testing the manual speed control will be conducted as follows:

1. On the precise model of the generator set, you must connect the manual speed control as follows (figure 3):

a. Push the manual speed control all the way in.

b. Insert manual speed control cable through sleeve of the fuel injection pump manual throttle control arm.

c. Install and tighten the adjustment screw.

d. Install lock wire.

NOTE

Now proceed with testing for the precise and utility sets.

2. Check the manual speed control for unrestricted movement.

3. Start the generator set; use the manual speed control to set generator output frequency.

NOTE

If you are unfamiliar with the starting procedures, refer to para 2-10, TM 5-6115-465-12.

4. Rotate the control knob 90 degrees. Frequency change should not change more than 1 percent for the 90 degrees rotation (0.6 Hz for 50/60 Hz generator sets and 4 Hz for 400 Hz generator sets).

5. Replace manual speed control if any test is not met.

C. Test the Fault Indicator for Proper Operation (figure 4).

Testing and placement of lamp and fuses will be conducted as follows:

1. To test the fault indicator depress "TEST or RETEST" switch and check that all indicator lights are lit.

2. If the light(s) does not light, replace the light(s) that is defective.

   a. Unscrew the lens and remove lamp.

   b. Inspect the lamp for corrosion, cracked or broken glass, and burned out filament.

   c. Replace the lamp if defective.

   d. If none of the lamps come on when the "TEST RETEST" switch is depressed, check the fuse as follows:

      (1) Unscrew cap and remove fuse.

      (2) Inspect fuse for corrosion, or broken glass, and melted conductor.

      (3) Replace defective fuse.

      (4) Install fuse and cap.

This completes the lesson. You are now ready to take the Self-Check Test.

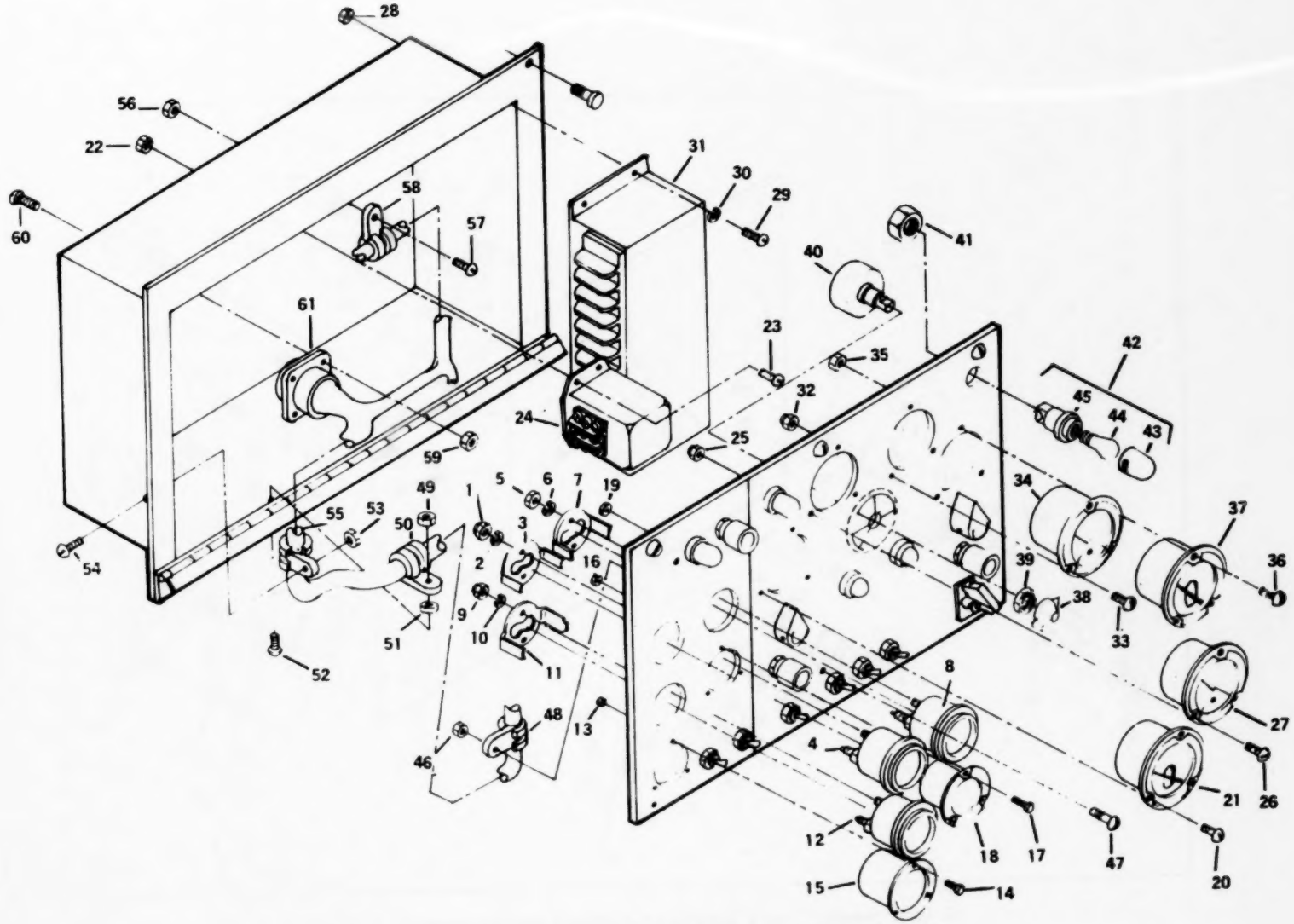

Figure 1. Control Cubicle Assembly, Exploded View (Sheet 1 of 3)

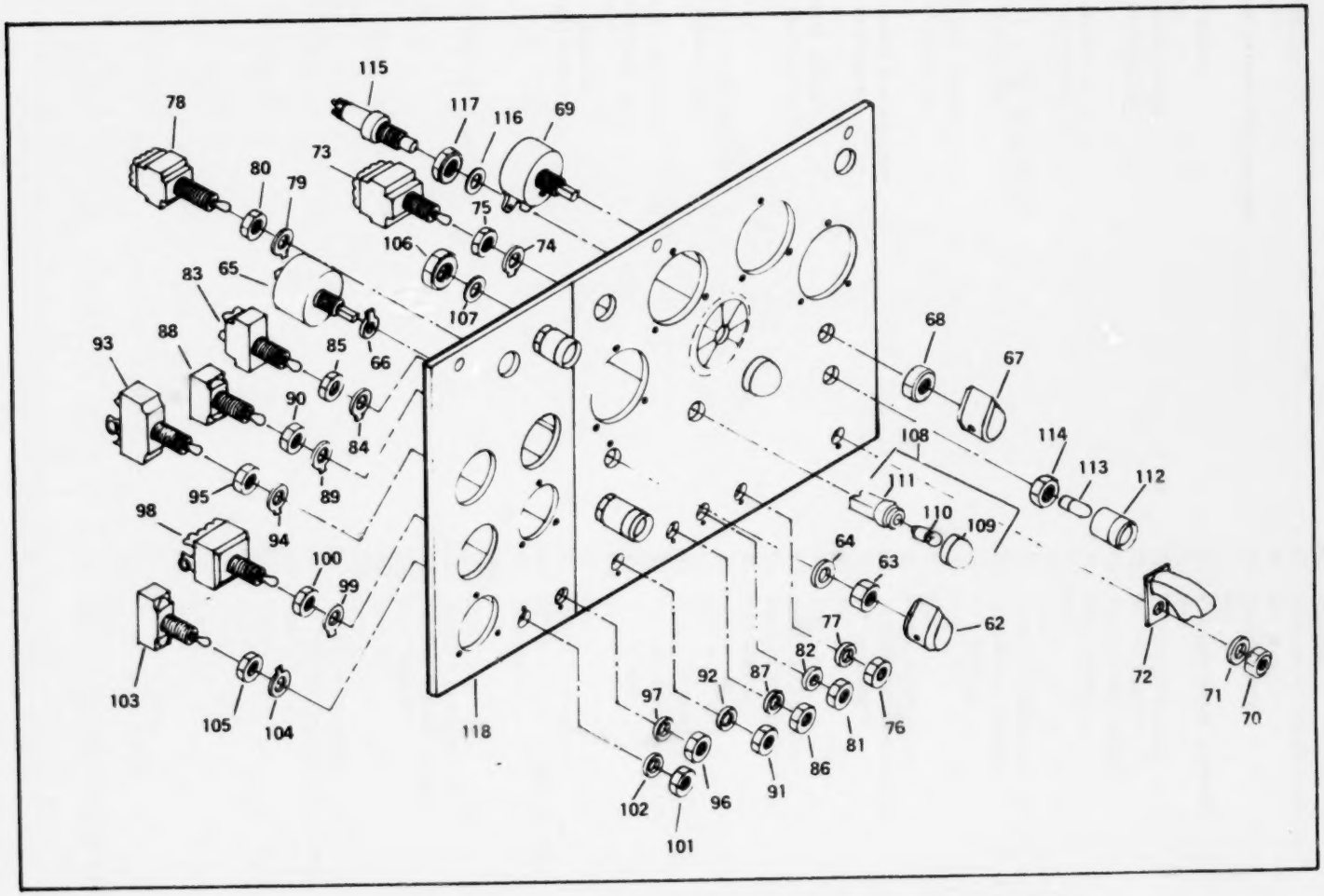

Figure 1. Control Cubicle Assembly, Exploded View (Sheet 2 of 3)

1. Nut
2. Lockwasher
3. Clamp
4. Oil pressure gauge
5. Nut
6. Lockwasher
7. Clamp
8. Coolant temperature gauge
9. Nut
10. Lockwasher
11. Clamp
12. Fuel level gauge
13. Self-locking nut
14. Screw
15. Hourmeter
16. Self-locking nut
17. Screw
18. Battery charging ammeter
19. Self-locking nut
20. Screw
21. Frequency meter
22. Self-locking nut
23. Screw
24. Frequency transducer
25. Self-locking nut
26. Screw
27. Kilowatt meter
28. Self-locking nut
29. Screw
30. Washer
31. Thermal watt converter
32. Self-locking nut
33. Screw
34. AC current meter
35. Self-locking nut
36. Screw
37. AC voltmeter
38. Control knob
39. Nut
40. Switch
41. Nut
42. Panel light assembly
43. Cover
44. Lamp
45. Base
46. Self-locking nut
47. Screw
48. Clamp
49. Self-locking nut
50. Clamp
51. Self-locking nut
52. Screw
53. Self-locking nut
54. Screw
55. Clamp
56. Self-locking nut
57. Screw
58. Clamp
59. Self-locking nut
60. Screw
61. Wiring harness assembly
62. Control knob
63. Nut
64. Washer
65. Frequency adjust rheostat
66. Key washer
67. Control knob
68. Nut
69. Voltage adjust rheostat
70. Nut
71. Tooth lockwasher
72. Switch guard
73. Battle short switch
74. Key washer
75. Nut
76. Nut
77. Tooth lockwasher
78. Operations switch
79. Key washer
80. Nut
81. Nut
82. Tooth lockwasher
83. Voltage sensing switch
84. Key washer
85. Nut
86. Nut
87. Tooth lockwasher
88. Panel light switch
89. Key washer
90. Nut
91. Nut
92. Tooth lockwasher
93. Circuit breaker switch
94. Key washer
95. Nut
96. Nut
97. Tooth lockwasher
98. START-RUN-STOP switch
99. Key washer
100. Nut
101. Nut
102. Tooth lockwasher
103. Engine primer switch
104. Key washer
105. Nut
106. Nut
107. Tooth lockwasher
108. Synchronizing light assembly
109. Lens
110. Lamp
111. Base
112. Lens
113. Lamp
114. Nut
115. Base
116. Tooth lockwasher
117. Nut
118. Control cubicle assembly panel

Figure 1. Control Cubicle Assembly, Exploded View (Sheet 3 of 3)

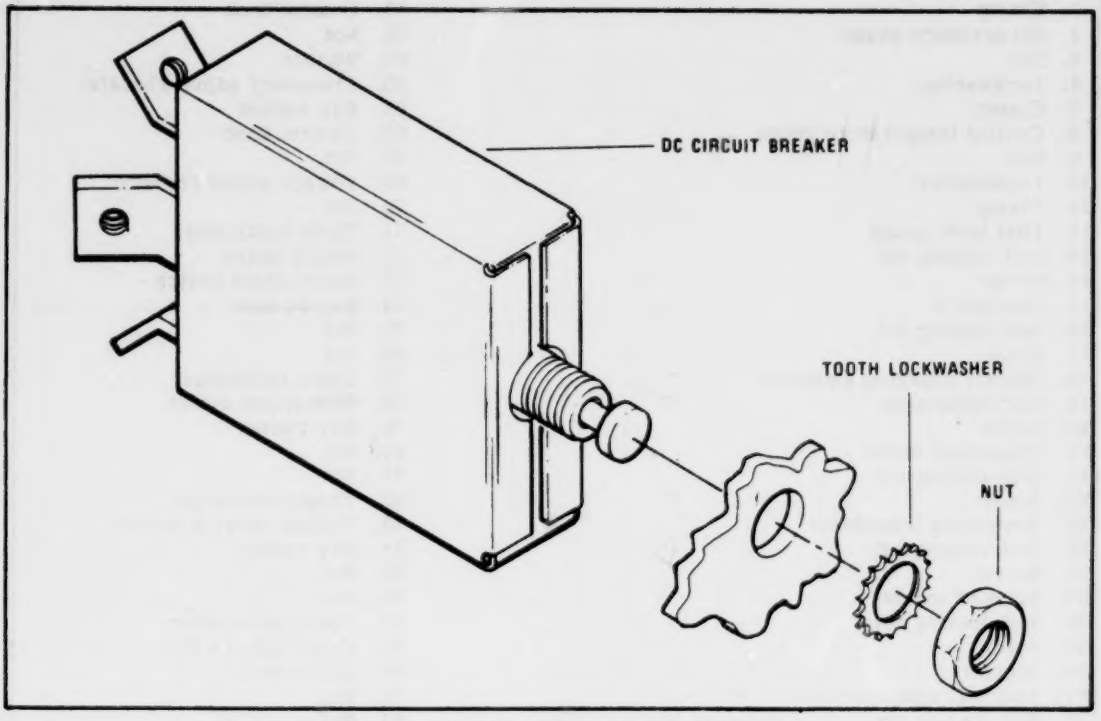

Figure 2. DC Circuit Breaker, Removal and Installation

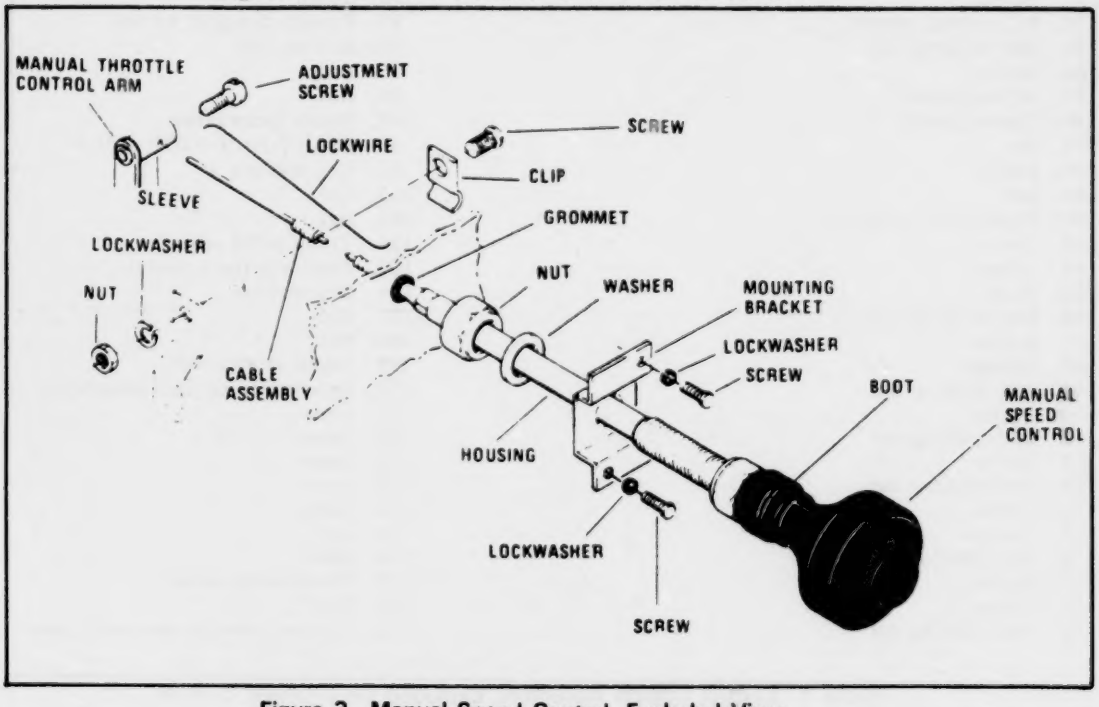

Figure 3. Manual Speed Control, Exploded View

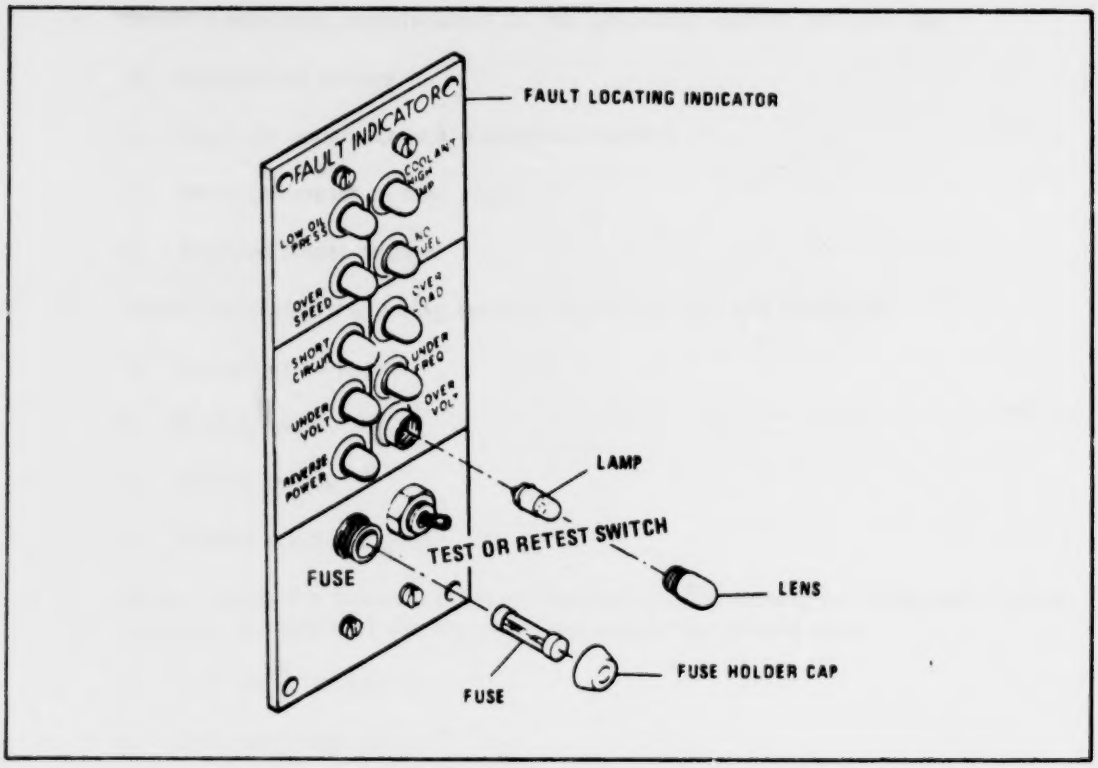

Figure 4. Fault Locating Indicator Lamp and Fuse Replacement

SELF-CHECK TEST

SET 1

LESSON: Troubleshoot the Control Panel (Organizational).

Circle the letter(s) denoting the correct response.

Questions:

1. **Before performing maintenance on the generator control box you will.**

   A. **Remove all covers.**

   B. **Shut off generator and disconnect battery.**

   C. **Place generator in cool place.**

   D. **Remove diesel engine.**

2. **When inspecting the wiring harness assembly you will check for**

   A. **Broken or bent pins.**

   B. **Broken glass.**

   C. **Broken lamps.**

   D. **Broken supports.**

3. **When testing the frequency adjust rheostat by connecting an ohmmeter. Across the outer terminals of the rheostat, the ohmmeter should read.**

   A. 100 ohms resistance.

   B. 250 ohms resistance.

   C. 600 ohms resistance.

   D. 500 ohms resistance.

4. **Before removing any component of the control box you will.**

   A. **Disconnect electrical leads.**

   B. **Remove flywheel.**

   C. **Loose control knob.**

   D. **Remove all nuts and washers.**

5. The ohmmeter reading when testing the voltge adjust rheostat should be.

   A. 300 ohms resistance.

   B. 200 ohms resistance.

   C. 250 ohms resistance.

   D. 350 ohms resistance.

6. To test manual speed control on a precise generator set for operation, you should first.

   A. Push manual speed control all the way in.

   B. Pull manual speed control all the way out.

   C. Turn manual speed control counterclockwise.

   D. Turn manual speed control clockwise.

7. When testing the fault indicator you will

   A. Pull the switch and check lights.

   B. Depress the switch and check lights.

   C. Turn the switch clockwise and check lights.

   D. Turn the switch counterclockwise and check the lights.

8. If the AC voltmeter is suspected of being faulty, test by replacing with another AC voltmeter.

   A. True

   B. False

9. You must replace the manual speed control, if any test is not met.

   A. True

   B. False

10. **The hydraulic actuator changes the governor setting.**

    A. **True**

    B. **False**

Now check your answers.

SELF-CHECK ANSWERS

LESSONS: Troubleshoot the Control Panel (Organizational)

1. B — shut off generator and disconnect battery
2. A — broken or bent pin
3. D — 500 ohms resistance
4. A — disconnect electrical leads
5. C — 250 ohms resistance
6. A — push manual speed control all the way in
7. B — depress the switch and check light
8. A
9. A
10. A

Note: If you missed some of the Self-Check Questions, you must review the lesson again. When you are confident that you know the material, you are ready for the Practice Activity. With the instructor's help you will practice the tasks until you can do all the items on the Performance Checklist. Now report to the Control Center with your Student Guide to be scheduled for the Practice Activity and Performance Tests.

PERFORMANCE TEST DIRECTIONS

LESSON: Troubleshoot the Control Panel (Organizational)

TEST DIRECTIONS:

1. At this site you will find 30 kw generator set, diesel engine driven, general mechanic's tool kit, ohmmeter, and TM 5-6115-465-12. All of this material may be used by you during your testing.

2. To be rated a "GO" on this test, you will be required to receive a "GO" on every step on the Performance Checklist.

3. On this test you must:

   Troubleshoot control box assembly components

   a. Inspect wiring harness for defects

   b. Test AC voltmeter for operation

   c. Inspect thermal watt converter

   d. Test rheostats for resistance

   e. Inspect frequency transducer for defects

   f. Test operation switches

   g. Inspect gages for external damage

   Troubleshoot generator set control

   a. Test DC circuit breaker terminals for operation

   b. Test manual speed control for operation

   c. Test fault indicator for defects

4. If you have questions concerning the test, ask the instructor now. You may not ask the instructor for any help while taking this test.

5. Specific Equipment:

   _____

   _____

   _____

   _____

PERFORMANCE CHECKLIST

LESSON: Troubleshoot the Control Panel (Organizational)

SUTDENT'S NAME: _____

TEST COMPLETION DATE: _____

For the student to receive a "GO" on this test, the student must receive "GOs" on a minimum of five of the nine checklist items. The five chosen for testing will be at the instructor's discretion.

Did the Student:	TEST GO	TEST NO GO	RETEST GO	RETEST NO GO	REMARKS
Troubleshoot control box assembly components:					
a. Inspects wiring harness for defects.					
b. Test AC voltmeter for operation.					
c. Inspects wattmeter converter for external damage.					
d. Tests rheostats for resistance.					
e. Inspects frequency transducer for defects.					
f. Tests switches for operation.					
g. Inspects gages for external damages.					
Troubleshoots generator set controls:					
a. Tests DC circuit breaker terminals for operation.					
b. Tests manual speed control for operation.					
c. Tests faults indicator for defects.					

Evaluators Signature _____

REFERENCES

TM 5-6615-465-12